

Remarks

The Examiner's indication that all of the items listed in the Information Disclosure Statement (hereinafter, "First IDS") that was submitted on May 20, 2003 have been considered, is acknowledged and much appreciated. A Supplemental Information Disclosure Statement was submitted on June 26, 2003 and consideration thereof is respectfully requested. The publication dates associated with item numbers 58 and 59 listed in the First IDS are November 15, 2001. Publication dates associated with item numbers 50 and 51 listed in the First IDS (i.e., the two Quirino *et al.* references mentioned by the Examiner on page 8 of the Office Action, page 8), are not known, although they may (*arguendo*) have been available on the Analytical Chemistry website about a month prior to the publication dates associated with items 59 and 58, respectively.

The specification has been amended in one paragraph merely to reflect that the term "metal organic" sometimes appears in literature as "metalorganic" and refers to a material that has an organic ligand attached to a metal atom or a metalloid atom. This paragraph has further been amended to indicate that the term "metal alkoxide" refers to a member of the "metal organic" or "metalorganic" family, such that it also refers to a material that has an organic ligand attached to a metal or metalloid atom. As such, the term "metal" when used in connection with a "metal organic" or "metalorganic" material or a "metal alkoxide" encompasses metals and metalloids, as is consistent with the list of "metals" also appearing in the paragraph, which includes metals and metalloids. Support for these amendments appear in the original specification and also in Brinker, C. Jeffrey, *et al.*, *Sol-Gel Science, The Physics and Chemistry of Sol-Gel Processing*, page 2 (1990), a copy of which is submitted herewith. No new matter has been added by virtue of these amendments to the specification.

Claim 6 has been cancelled, such that Claims 1-5 and 7-35 are pending. Claims 12-35 have been withdrawn from consideration. Thus, Claims 1-5 and 7-11 are now under consideration.

Claim 1 has been amended to reflect that the support comprises a metal organic photopolymer from a metal alkoxide precursor. Claim 7 has been amended in terms of dependency, given the cancellation of Claim 6. Claim 7 has also been amended to reflect that the metal alkoxide comprises a metal or a metalloid selected from a group, as recited. The amendment of Claim 7 simply makes express what was inherent in the claim, as discussed above in relation to the term "metal" as used in connection with the term "metal alkoxide." Claim 7 has not been narrowed by virtue of this amendment. Claim 8 has been amended in

terms of dependency, given the cancellation of Claim 6. Claim 8 has not been narrowed by virtue of this amendment.

Claims 1-5 and 7-11 were rejected under 35 U.S.C. Section 102(a) as allegedly being anticipated by, or in the alternative under 35 U.S.C. Section 103(a) as allegedly being obvious over, each of an article of M. Dulay *et al.*, *Photopolymerized Sol-Gel Monoliths for Capillary Electrochromatography*, Anal. Chem., Vol. 73, No. 16 (2001), 3921-3926 (hereinafter, "Dulay I") and an article of Kato *et al.*, *Photopolymerized Sol-Gel Frits for Packed Columns in Capillary Electrochromatography*, Journal of Chromatography A, 924 (2001), 187-195 (hereinafter, "Kato").

Declarations under 37 C.F.R. 1.132 concerning Dulay I and Kato, respectively, are submitted herewith. It is submitted that these declarations render Dulay I and Kato, respectively, inapplicable to Claims 1-5 and 7-11.

In view of the foregoing, it is respectfully submitted that Claims 1-5 and 7-11 define novel and non-obvious subject matter of the subject invention, notwithstanding each of Dulay I and Kato.

Claims 1-5 and 7-11 were rejected under 35 U.S.C. Section 103(a) as allegedly being unpatentable over an article of Dulay *et al.*, *Preparation and Characterization of Monolithic Porous Capillary Columns Loaded with Chromatographic Particles*, Anal. Chem., Vol. 70, No. 23 (1998), 5103-5107 (hereinafter, "Dulay II") in view of an article of Viklund *et al.*, *"Molded" Macroporous Poly(glycidyl methacrylate-co-trimethylolpropane trimethacrylate) Materials with Fine Controlled Porous Properties: Preparation of Monoliths Using Photoinitiated Polymerization*, Chem. Mater., Vol. 9 (1997), 463-471 (hereinafter, "Viklund"), an article of Woo *et al.*, *Photopolymerization of Methyl Methacrylate with Primary Aryl- and Alkylsilanes*, Bull. Korean Chem. Soc., Vol. 16, No. 11 (1995), 1056-1059 (hereinafter, "Woo"), and each of U.S. Patent No. 5,624,875 of Nakanishi *et al.* (hereinafter, "Nakanishi"), U.S. Patent No. 6,398,962 of Cabrera *et al.* (hereinafter, "Cabrera"), and U.S. Patent No. 6,210,570 of Holloway (hereinafter, "Holloway"). These rejections are respectfully traversed.

Claim 1 and Claims 2-5 and 7-11 depending therefrom are directed to a separation column comprising a separation channel and a separation medium in the channel, said medium comprising a porous matrix, said porous matrix comprising a support and a stationary phase, said support comprising a metal organic photopolymer from a metal alkoxide precursor, and said stationary phase comprising a bonded phase.

At the outset, the Examiner states that "[t]he claims differ from [Dulay II] in reciting irradiating the mixture...." Applicants believe the Examiner has misread Claims 1-5 and 7-11, as no such recitation appears in these claims.

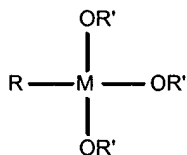
The Examiner's indication that Dulay II fails to teach or suggest a bonded phase is noted. Dulay II fails to teach or suggest a metal organic photopolymer. Dulay II also fails to teach or suggest a metal organic photopolymer from a metal alkoxide precursor. As to Claim 5, it is noted that Dulay II teaches a separation column with a porous matrix in a separation channel that contains chromatographic particles, such as octadecylsilica particles, and fails to teach or suggest a porous matrix that contains no chromatographic particles.

Viklund also fails to teach or suggest a metal organic photopolymer from a metal alkoxide precursor. That is, Viklund's photopolymer results from the photopolymerization of glycidal methacrylate and trimethylolpropane trimethacrylate. These precursors are not metal alkoxides and the resultant photopolymer is not a metal organic.

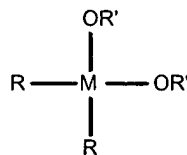
The Examiner alleges that Woo teaches that it is well known to photopolymerize silanes. Applicants strongly disagree. Woo teaches photopolymerization of methylmethacrylate with the aid of an arylsilane or various alkylsilanes to produce poly(methylmethacrylate) having a silyl moiety as an end group. (See Woo's Abstract, Eq. 1, and Scheme 1.) No silane is photopolymerized, such that the Examiner's allegation that Woo teaches that it is well known to photopolymerize silanes is believed to be in error and misapplied in these rejections.

As to Woo's polymer precursors, methylmethacrylate is not a metal alkoxide; the arylsilane, phenylsilane, is not a metal alkoxide; and none of the alkylsilanes, benzylsilane, 3-phenoxyphenyl-1-silabutane, 3-naphthyl-1-silabutane, or 3-chlorophenyl-1-silabutane, is a metal alkoxide. For the convenience of the Examiner, structures for exemplary metal alkoxides are set forth below, as are the structures of Woo's phenylsilane, benzylsilane, 3-phenoxyphenyl-1-silabutane, 3-naphthyl-1-silabutane, and 3-chlorophenyl-1-silabutane.

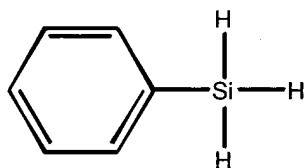
- I. Structures for Examples of Metal Alkoxides, $(R_{4-x}) - M - (OR'_x)$, where M is a metal or a metalloid, R and R' are organic groups, and OR' is an alkoxy group.



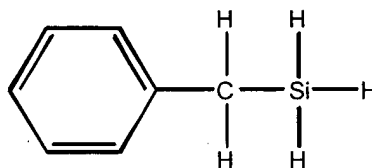
OR



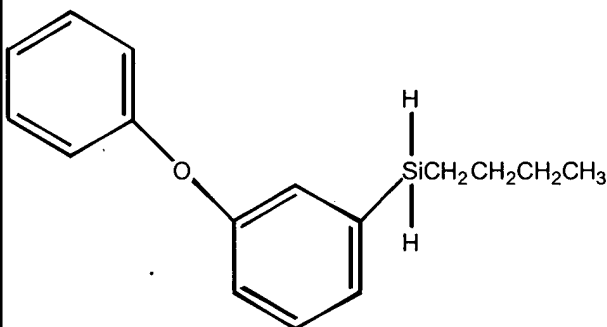
- II. Structures for Woo's phenylsilane, benzylsilane, 3-phenoxyphenyl-1-silabutane, 3-naphthyl-1-silabutane, and 3-chlorophenyl-1-silabutane.



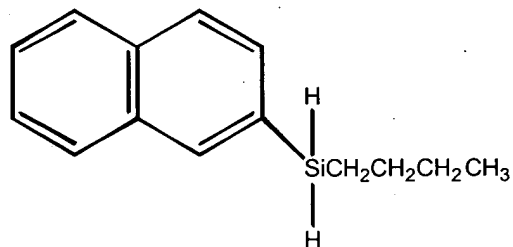
phenylsilane



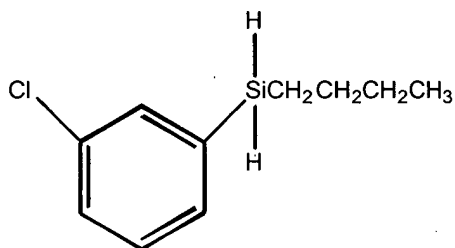
benzylsilane



3-phenoxyphenyl-1-silabutane



3-naphthyl-1-silabutane



3-chlorophenyl-1-silabutane

Woo thus fails to teach or suggest a metal organic photopolymer from a metal alkoxide precursor.

Further, each of Nakanishi, Cabrera, and Holloway fails to teach or suggest a metal organic photopolymer, let alone a metal organic photopolymer from a metal alkoxide precursor.

In view of the foregoing, it is submitted that one of ordinary skill in the art would have had no motivation, at the relevant time, to combine the disparate references of Dulay II, in view of Viklund, Woo, and each of Nakanishi, Cabrera, and Holloway, in the manner hypothesized by the Examiner, and even if one so skilled would have been so motivated, *arguendo*, he or she would not have arrived at the present invention. It is respectfully submitted that the rejections of Claims 1-5 and 7-11 over Dulay II, in view of Viklund, Woo, and each of Nakanishi, Cabrera, and Holloway, have been overcome and should be withdrawn.

Claims 1-5 and 7-11 have been rejected under 35 U.S.C. Section 103(a) as allegedly being unpatentable over each of Nakanishi, Cabrera, and Holloway, in view of Viklund and Woo. These rejections are respectfully traversed.

At the outset, the Examiner states that "[t]he claims differ from each of [Nakanishi, Cabrera, and Holloway] in reciting irradiating the mixture...." Applicants believe the Examiner has misread Claims 1-5 and 7-11, as no such recitation appears in these claims.

As set forth in the remarks above concerning each of Nakanishi, Cabrera, and Holloway, which remarks are incorporated herein by reference, each of Nakanishi, Cabrera, and Holloway fails to teach or suggest a metal organic photopolymer, or a metal organic photopolymer from a metal alkoxide precursor. Further, as set forth in the remarks above concerning Viklund and Woo, which remarks are incorporated herein by reference, Viklund fails to teach or suggest a metal organic photopolymer, or a metal organic photopolymer from a metal alkoxide precursor; Woo does not teach that it is well known to photopolymerize silanes, as alleged by the Examiner; and Woo fails to teach or suggest a metal organic photopolymer from a metal alkoxide precursor.

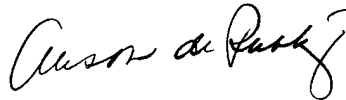
In view of the foregoing, it is submitted that one of ordinary skill in the art would have had no motivation, at the relevant time, to combine the disparate references of each of Nakanishi, Cabrera, and Holloway, in view of Viklund, and Woo, in the manner hypothesized by the Examiner, and even if one so skilled would have been so motivated, *arguendo*, he or she would not have arrived at the present invention. That is, even if the hypothesized

combination of each of Nakahishi, Cabrera, and Holloway, in view of Viklund and Woo were possible, *arguendo*, neither Viklund and Woo alone, nor the combination thereof, would have made up for the deficiencies of each of Nakahishi, Cabrera, and Holloway. It is respectfully submitted that the rejections of Claims 1-5 and 7-11 over each of Nakahishi, Cabrera, and Holloway, in view of Viklund and Woo, have been overcome and should be withdrawn.

Conclusion

Claims 1-5 and 7-11 define novel and non-obvious subject matter of the present invention. Therefore, an early notification of allowability is earnestly solicited.

Respectfully submitted,



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SOL-GEL SCIENCE

The Physics and Chemistry of
Sol-Gel Processing

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1.

SOL-GEL PROCESSING

A *colloid* is a suspension in which the dispersed phase is so small ($\sim 1\text{--}1000\text{ nm}$) that gravitational forces are negligible and interactions are dominated by short-range forces, such as van der Waals attraction and surface charges. The inertia of the dispersed phase is small enough that it exhibits *Brownian motion* (or *Brownian diffusion*), a random walk driven by momentum imparted by collisions with molecules of the suspending medium. A *sol* is a colloidal suspension of solid particles in a liquid. An *aerosol* is a colloidal suspension of particles in a gas (the suspension may be called a *fog* if the particles are liquid and a *smoke* if they are solid) and an *emulsion* is a suspension of liquid droplets in another liquid. All of these types of colloids can be used to generate polymers or particles from which ceramic materials can be made. A *ceramic* is usually defined by saying what it is *not*: it is nonmetallic and inorganic; some would also say it is not a chalcogenide. We thus include all metal oxides, nitrides, and carbides, both crystalline and noncrystalline. In the sol-gel process, the *precursors* (starting compounds) for preparation of a colloid consist of a metal or metalloid element surrounded by various *ligands* (appendages *not* including another metal or metalloid atom). For example, common precursors for aluminum oxide include *inorganic* (containing no carbon) salts such as $\text{Al}(\text{NO}_3)_3$ and *organic* compounds such as $\text{Al}(\text{OC}_4\text{H}_9)_3$. The latter is an example of an *alkoxide*, the class of precursors most widely used in sol-gel research. An *alkane* is a molecule containing only carbon and hydrogen linked exclusively by single bonds, as in *methane* (CH_4) and *ethane* (C_2H_6); the general formula is $\text{C}_n\text{H}_{2n+2}$. An *alkyl* is a ligand formed by removing one hydrogen (proton) from an alkane molecule producing, for example, *methyl* ($\bullet\text{CH}_3$) or *ethyl* ($\bullet\text{C}_2\text{H}_5$) (where the dot \bullet indicates an electron that is available to form a bond). An *alcohol* is a molecule formed by adding a *hydroxyl* (OH) group to an alkyl (or other) molecule, as in *methanol* (CH_3OH) or *ethanol* ($\text{C}_2\text{H}_5\text{OH}$). An *alkoxy* is a ligand formed by removing a proton from the hydroxyl on an alcohol, as in *methoxy* ($\bullet\text{OCH}_3$) or *ethoxy* ($\bullet\text{OC}_2\text{H}_5$). A list of the most commonly used alkoxy ligands is presented in Table 1.

Metal alkoxides are members of the family of *metalorganic* compounds, which have an organic ligand attached to a metal or metalloid atom. The most thoroughly studied example is silicon tetraethoxide (or tetraethoxysilane, or tetraethyl orthosilicate, TEOS), $\text{Si}(\text{OC}_2\text{H}_5)_4$. *Organometallic* compounds are defined as having direct metal-carbon bonds, not metal-oxygen-carbon linkages as in metal alkoxides; thus, alkoxides are not organometallic compounds, although that usage turns up frequently in the

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State of California

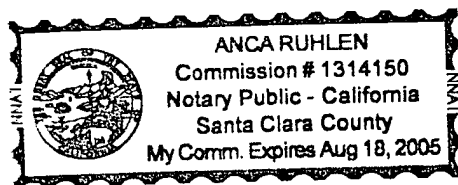
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Bryson D. Bennett

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